Watervliet Arsenal
Seacoast Gun Shop
(Building 110, Big Gun Shop)
South of Hagner Road between Schull Road and Whittemore Road
Watervliet
Albany County
New York

HAER No. NY-1B

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

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HISTORIC AMERICAN ENGINEERING RECORD

WATERVLIET ARSENAL
SEACOAST GUN SHOP
(Building 110, Big Gun Shop)
HAER No. NY-1B

Location:	South of Hagner Road between Schull Road and Whittemore Road, Watervliet Arsenal, Watervliet, Albany County, New York. UTM: 18.605720.4730245 Quad: Troy South
Date of Construction:	1889-1892.
Present Owner and Occupant:	U.S. Army
Present Use:	Manufacture of large caliber gun tubes
Significance:	The building is significant for its historic role as America's center for large caliber weapons manufacture since the late nineteenth century and because of its distinction as a work of nineteenth-century industrial design.
Historian:	Barbara E. Hightower, February 1985

PART I. HISTORICAL INFORMATION

A. Physical History:

1. Date of erection: The north wing and central section were begun in 1889 and completed in 1890 (Report of the Secretary of War, 1890, pp. 134-135). The south wing, begun in 1891, was completed the following year (Report of the Secretary of War, 1892, p. 358).

2. Architect: In September 1888, a board of Ordnance officers--Captain Charles Morrison, Lt. Colonel Francis H. Parker, Colonel James M. Whittemore, Captain Charles Shaler, and First Lt. William B. Gordon--was appointed to prepare plans, specifications, and estimates for "the erection, purchase, or manufacture of the necessary buildings and other structures, machinery, tools, and fixtures for an Army gun-factory for finishing and assembling heavy ordnance, to be erected at the Watervliet Arsenal..." (Report of the Secretary of War, 1889, pp. 14-15). Parker and Morrison were replaced by Colonel A. R. Buffington and Anthony Victorin, an Ordnance Department engineer, in February 1889. Victorin may have played an important role in designing the building since his name appears on a number of early plans on file in the arsenal's Engineering Division (see for example HAER Photo Nos. NY-1B-21 and 22, HAER Photo Nos. NY-1B-32 and 33, and HAER Photo Nos. NY-1B-38 and 39).

3. Original and subsequent owners: U.S. Army

4. Builder, contractor, suppliers: Contracts were awarded to: Elnathan Sweet of Albany for preparation and excavation of the site; to Charles Duncan of Troy for woodwork; to Stanton and Neary of Cohoes, New York for stone, brick masonry, and concrete; to Richard F. Hawkins of Springfield, Massachusetts for iron-work; to F. F. Brewer of Syracuse for slate roofing; and to Martin Hunt of Troy for cut stone (Report of the Secretary of War, 1889, p. 15).

5. Original plans and construction: Specifications for the building were published in the Report of the Secretary of War, 1889, pp. 273-286 and Report of the Secretary of War, 1891, pp. 412-438. The Engineering Division has a collection of 85 original or early drawings of the north and south wings and the central section (see HAER Photo No. NY-1B-19 through HAER Photo No. NY-1B-47). The drawings include elevations, plans, sections, cornices, and roof trusses. The building appears to have been constructed according to the plans.

6. Alterations and additions: By the late 1890s, problems originating with the design of the cornice arose. These included, "leaks in the roof, especially on the side aisles under the down spouts from main roof; deterioration of the brickwork of cornices everywhere, due to water leaking down into the wall or running into the joints on the face of the wall, this being rendered possible by insufficient overhang of the coping; finally, a very top-heavy construction of the cornices--too much weight in the corbelling on outside face of wall" (Report of the Secretary of War, 1900, p. 81). During 1900-1901, the coping and an average of three feet of the brick work was removed and replaced by the current brick corbelling (Annual Report of the War Department, 1901, pp. 121-128).

In 1916-1917, the south wing was extended on the south by six bays, and the southwest aisle was enlarged on the west (Kyle, p. 608). The addition, which matched the original building, appears on an aerial view of the arsenal taken in 1918 (HAER Photo No. NY-1A-83). The south wing was extended again in 1919-1920 with the addition of 10 bays matching the earlier construction. The addition provided facilities for the manufacture of 194 mm guns. Part of the sash and doors from the existing south elevation were reused. Drawings documenting these additions are on file in the Engineering Division. The central section was enlarged in 1917-1918 with the construction of a high bay (HAER Photo No. NY-1B-15).

The northern nine bays of the extension to the north wing were also erected in 1919 in their current configuration. An additional seven bays were built on the south in 1941 matching the earlier construction. Plans for both additions are in the Engineering Division.

The current welding shop was erected on the southwest side of the south wing in 1941. The Engineering Division has two drawings showing the floor plan of this largely unaltered addition.

Several additions to the building have recently been demolished under the arsenal's modernization program, Project REARM (HAER No. NY-1A). A one-story, gable-roofed brick structure containing wash-rooms and closets (Building 108) was erected between the seacoast gun shop and the field and siege gun shop in 1891. Passageways connected the three buildings. The building was later extended on the south, and a second passage connected it to the shop. The south end of Building 108 and the passageways have been demolished, but evidence of the north passageway remains on the east elevation of the shop (HAER Photo No. NY-1B-11).

In 1911, a blacksmith shop was added to the east extension of the central section. The east elevation essentially mirrored that of the earlier projection with windows set under round arches and flanked by decorative chimneys. By 1918, the addition was extended on the east with similar construction. Plans are on file in the Engineering Division. In that year, a new section was added on the north. On this addition, brick pilasters separate industrial steel sash below a corbelled brick cornice that was similar to the gun shop cornice. The addition was extended on the east by 1945 with similar construction. All sections have been demolished.

B. Historical Context:

In 1887 Watervliet Arsenal was selected as the Army's gun factory (see to Watervliet Arsenal, HAER No. NY-1A). A two-story, brick storehouse was immediately converted to manufacture smaller field and siege guns, primarily 3.2-, 8-, and 10-inch breech-loading steel guns. Provision was soon made for expansion of production facilities; the 1888 appropriation for fortifications authorized "the erection, purchase, or manufacture of the necessary buildings and other structures, machinery, tools, and fixtures for an army gun factory for finishing and assembling heavy ordnance..." (Report of the Secretary of War, 1890, p. 134). The new shop was to consist of a north wing where 8-inch, 10-inch, and 12-inch guns would be manufactured, a central section containing a shrinkage pit, boiler house, and rail lines crossing the building, and provision for extension of the shop with a wing on the south. The Seacoast Gun Shop's north wing and central section were erected west of the Field and Siege Gun Shop in 1889-1890, and production got underway on November 9, 1890. Over the next eight months, a 12-inch gun, a 10-inch cast-iron wire-wound gun, and a 12-inch steel mortar were completed, and work was begun on a 10-inch steel wire-wound gun, twelve 8-inch guns, four 10-inch guns, and a 12-inch gun (Report of the Secretary of War, 1891, pp. 122-123).

The Ordnance Department decided to postpone construction of the south wing "until after some practical experience had been gained in the installation of a plant of this kind" (Report of the Secretary of War, 1890, pp. 12-13). Shortly before completion of the north wing and centrsl section, the need to provide larger guns to arm the country's seacoast fortifications led the Department to request funding for expansion of the building (Ibid, p. 14). The wing, constructed in 1891-1892, was 30' wider than the north wing to accommodate production of 16-inch guns. Manufacture of these guns didn't begin until 1899, and the first was not completed until 1902 (see Notes on the Construction of Ordnance--No. 78).

The building's design was well suited for its purpose. The length of the wings provided for consolidation of the machinery needed to transform a rough-bored forging into a finished gun tube in one location. Arches in the bearing walls between the main and side aisles allowed for extension of larger machinery, such as lathes, from the center into the side aisles. Illumination for interior work spaces was gained through the numerous large windows lining the sides of the building. Large doors opened on the sides of the central section so that forgings and finished gun tubes could be transported along the rail lines that ran between the Delaware and Hudson Canal Company line on the west side of the arsenal and the arsenal's wharf on the Hudson River to the east. The rail lines passed over the Erie Canal on a wrought-iron riveted lattice single-track through railway bridge built in 1889 (the bridge was demolished in the early 1940s when the Canal bed was filled in).

When completed, the building was outfitted with machinery procured from private contractors. While much of the machinery was "of commercial sizes and character, some had to be "specially adapted, either in whole or in part, for gun work" (Report of the Secretary of War, 1890, p. 136). The latter was especially true for the larger lathes, since these were of "unusual dimensions, and their manufacture...nearly tantamount to the establishment of a new industry" (Ibid, p. 13). The larger machines, including turning and boring lathes, turning and finishing lathes, jacket lathes, and rifling machines, were placed across the center aisles of the north and south wings, and smaller machinery, like hoop lathes, boring mills, upright drills, and shapers, were set in the side aisles (for layout of the machinery, see Report of the Secretary of War, 1893, Appendix 21, Plate II and Sheets 6 and 7 of the Measured Drawings for HAER No. NY-1A). Gun tube components were moved through the various stages of production by overhead traveling cranes that ran along rails on the overhead longitudinal girders of the center and side aisles.

The shop's steam power plant was located in an extension on the west side of the central section. The equipment, set up in the plant by Fitchburg Steam Engine Company in 1890, consisted of "a battery of three tubular boilers 6 by 16 feet each (and) a 250 horse-power double cylinder engine, with all the connections and fixtures belonging to the most approved modern designs" (Report of the Secretary of War, 1890, p. 137). Power was transmitted from the main driving shaft in the plant to the shop's east and west sides by an underground shaft on pillow blocks (Ibid, p. 136). The machinery was connected to the underground shaft by a system of shafts, pulleys, and belts. Coal to fire the boilers was stored in bins adjacent to the plant on the west. The shop's overhead cranes were run by

"two Siemens and Halske 90 kilowatts direct-current compound-wound dynamos, designed to run at a speed of 680 revolutions per minute, giving an output of 360 amperes, at 250 volts" (Annual Report of the War Department, 1899, p. 217). The dynamos, located in the engine room on the west side of the building's central section, were also used to power the machinery in the Broadway Shops whenever water was drained from the Erie Canal.

The shrinkage pit, located in the shop's central section, was excavated through shale rock to a depth of 50 feet. Its configuration was described in the 1891 Ordnance Report:

> At its opening it is 40 feet by 20 feet and has a maximum depth of 50 feet. At a depth of 20 feet the dimensions are 20 by 20 feet; at a depth of 35 feet they are 20 feet by 10 feet. On the 20-foot level are to be situated the heating furnaces. The 35-foot level is to be used for 12-inch guns, or of less caliber, while the 50-foot level is designed for guns of still greater caliber. ...work was commenced in the machine shops to construct frames of I-beams for the edges of the top opening and that of each of the lower levels. The excavation left the pit irregular. The sides and lower platforms were in places shelved off so that instead of being straight and level, as was intended, they were uneven and inclined. This necessitated the construction of the heavy frames around the openings, and forming floors of concrete or masonry laid up to and terminated by the beams. Over this on the ground floor is laid the asphalt floor extending some distance from the pit. At the 20-foot level brick arches are turned to cover the opening between the beams and the rock platforms. (Report of the Secretary of War, 1890, pp. 135-136)

Although excavation was begun in 1889, the pit was not completed and in operation until January 1892. A lack of appropriations and serious problems with water seepage through the shale rock prolonged construction. The water problem was finally solved by a "20-inch drain which connects at its upper end with a tunnel from the pit 23 feet under the shop floor, and at its lower end with the new drainage system to the river" (Ibid, p. 136).

During the construction phase, studies were done to determine the best methods of heating and cooling gun components in the pit. Recommendations included the use of gas and horizontal furnaces for heating and a large immersion tank for cooling. These methods were found inadequate, and the pit was finally equipped with water ring coolers and two vertical coal furnaces vented through a brick flue

connected to the boiler room stack (Report of the Secretary of War, 1892, p. 358).

Equipment in the pit was later updated or modified for shrinkage of larger guns. Around 1894, the jacket-heating furnace was expanded to accommodate the greater length of the 40 caliber 12-inch gun Model 1892 by means of an extension placed at the top of the furnace. The extension could be removed for heating other 12-inch models and guns of smaller calibers (Report of the Secretary of War, 1894, pp. 152-153 and Appendix 14, Plate V). Operation of the extended furnace was described in the Report of the Secretary of War for 1894 (pp. 152-153):

> The extension is heated independently from the main furnace by means of a fire box located on the 20-foot level...From this the hot gases ascend to an annular flue at the top of the extension, which has a number of adjustable openings on the circumference of its inner wall for the admission and uniform distribution of the hot gases into the space between the inner steel cylinder, which surrounds the jacket, and the outer fire-brick lined shell of the furnace extension. Another annular flue with openings on its inner wall is at the bottom of the extension. This collects the gases again and from it leads a flue to the chimney. The flue leading from the grate to the extension is provided with a damper or gate valve to check the flow of gases partly, or altogether, when the extension is to be removed. A similar gate valve is in the flue between the extension and the flue leading to the chimney. The extension is provided with attachments for handling it by means of one of the traveling cranes.

The pit was further modified in 1898 when a new coal oil furnace was added for production of the 16-inch gun. In his report to the Ordnance Department, Watervliet's commander noted that similar oil furnaces were used by many manufacturers and had been "in satisfactory operation at Frankford Arsenal for some years" (Report of the Secretary of War, 1898, p. 213). An experimental oil furnace installed in the shrinkage pit of the Field and Siege Gun Shop in 1897 was also operating satisfactorily. The new furnace in the Seacoast Gun Shop consisted of:

> ...a vertical, cylindrical 13-inch fire-brick wall resting upon solid rock in the southeast corner of the shrinkage pit. Being upon the 30-foot level and 27 feet 9 inches high, its top is 2 feet 3 inches below the floor level. Fuel oil is supplied through a 3-inch pipe from a 5,000-gallon tank upon the hill, and enters the furnace through twenty burner openings in five tiers of four burners each. The burner

consists of an oil pipe with a small steam pipe inside, and in the inner end of each pipe is a small hole.

The steam, issuing with high velocity through the small opening in the end of the pipe, carries the oil with it as a spray, and its oxygen, combining with the oil, gives an exceedingly hot flame. The direction in which the burner points may be slightly varied by the bolts and nuts..., the pieces...forming a kind of ball-and-socket joint of limited motion. To prevent the hoops being excessively heated where the flames would impinge, causing unequal expansion and even affecting injuriously the physical properties of the metal, a muffle or cylinder of one-half inch boiler steel surrounds the hoop to be heated, and prevents actual contact of the burning gases with it. This muffle transmits the heat at all points equal. The furnace has a removable steam cover to confine the heat and gases. The gaseous products of combustion are drawn off through the flue connecting with the main chimney flue. A damper is available for holding back the gases until they have imparted to the work as much of their heat as may be desired.

The temperature in the furnace may be partially controlled thus, and is also governed by the number of jets burning and by the adjustment of the amount of oil and steam admitted. For this last purpose there are valves upon the oil and steam pipes entering each burner. In order to observe the flame and determine if it is burning properly, each burner is surmounted by an observation opening through the brick wall, closed by a mica door.

The uniformity of heating, which is most important, is one reason for the tangential direction in which the burners enter the combustion chamber, causing a rapid spiral motion of the burning gases about the muffle. (Ibid, pp. 213-214)

The remaining coal furnaces in the pit were replaced by an oil and high-pressure steam heating furnace in 1900. The 20-foot high furnace was similar to the one erected for 16-inch guns two years earlier. Removal of the coal furnaces, which freed the pit from ashes and cinders, also allowed installation of a circulating water system. With the new system, water for cooling was reused instead of being pumped into the sewer after each cooling process, thus reducing the shop's water consumption by about 200,000 gallons per week (Annual Report of the War Department, 1901, p. 101). By 1920 the furnace was so dilapidated that it was replaced by an electric

furnace 71' 8" in depth. The pit was also enlarged in 1920, and a second electric furnace, an oil burning furnace, and an elevator and stair descending to 71' 8" were added (Kyle, p. 649).

While large-caliber weapons had previously been manufactured in the United States, they had all been cast as a single piece. The majority of weapons turned out at Watervliet, including the enormous 16-inch guns, were "built-up" of several components that required a more complicated and lengthy process of production but which vastly increased their strength and durability.

Built-up guns consisted of four major components: the breech mechanism, a tube, a jacket, and four sets of hoops labeled "A," "B," "C," and "D" (Farley, p. 77). At Watervliet, the gun tube forging was rough-bored and its shrinkage surfaces turned on lathes. The tube was then lowered muzzle down into the shrinkage pit. Turned and fitted C hoops were heat-expanded in the pit's furnace and lowered into place over the rear portion of the tube. Cooled by water in the pit, the hoops shrank tightly around the tube, compressing the metal within it. The tube was then removed from the pit and gauged on a lathe to insure it had not warped during shrinkage, then returned to the pit where its jacket was shrunk in place on the breech end. The same process was repeated for the D, A, and B hoops, which secured the jacket in place. When shrinkage was completed, the gun tube underwent final boring, rifling, and emplacement of the breech mechanism.

A variation was made in the normal shrinkage process for the first 16-inch gun. After the D hoops had been shrunk in place, "The weight of the gun...was so great, nearly 200,000 pounds, that it was not considered safe to carry it along the craneway until after the latter had been strengthened and received the new rails for the wheels of the crane. The shrinkage of the A hoops (was) consequently...made with the gun in a horizontal position in the lathe where the shrinkage surface was turned, the heated hoops being carried by the crane to the gun instead of bringing the gun to the shrinkage pit" (Farley, p. 10).

The lengthy shrinkage process was based on the following principle:

> In discharging a projectile, a gun is subject to two fundamental stresses, a circumferential tensile stress, which tends to split the gun open longitudinally, and a tensile stress, which tends to pull the gun apart lengthwise. The longitudinal strength of a gun is usually greatly in excess of requirements, and so, in designing a gun, particular attention is paid to insure adequate circumferential strength.

> The pressure that a cast gun can safely withstand is less than that which would expand its inner fibers to the elastic limit of the metal. It is useless to merely thicken a gun after a certain thickness has been reached, due to the fact that the stresses on the metal near the bore are far higher than those on the metal of the outer portion of the gun, and hence the metal at the bore soon reaches its maximum resistance, which the added thickness of metal does not materially increase.
>
> If, however, a cast gun could be compressed until its inner fibers reached their elastic limit for compression, the strength of the gun would be practically doubled, since a pressure could be introduced to bring these fibers from the state of compression to the normal state and then up to the elastic limit for expansion (Olson, p. 156).

Production methods were later modified to increase the life of guns. Because of high powder pressures which caused the interior of gun tubes to deteriorate rapidly, removable liners that could be replaced periodically were developed. These ahrunk-in liners were inserted by the following process, which required about six weeks to complete:

> ..the gun is lowered into the electric furnace with the breech end uppermost.
>
> The liner is prepared for assembly by having the bore threaded at each end to receive plugs for retaining water that is circulated in the liner after it has been lowered into the heated gun. The liner is filled with water before being lowered into the gun, which remains in the furnace. As soon as the liner is seated in the gun, a connection is made to an inlet pipe in the breech plug and water is turned on, the excess water escaping through overflow pipes. At the same time, a hydraulic equipment, which has been suspended from another crane, is brought over the furnace and attached to the gun to exert a pressure of 200 tons on the liner, thus firmly holding it on its seat in the main tube.
>
> The instant that pressure is exerted by the hydraulic equipment, a valve is operated to lower the water level in the liner and thus permit a certain amount of the upper liner portion to take on the heat of the gun. At proper intervals, other valves are opened to successively reduce the water level until the entire external liner surface has come into contact with the heated main tube. In this process, the

> liner becomes expanded within the main tube and is firmly gripped as the entire unit contracts in cooling. (Herb, p. 166)

Removal or "unshrinking" of liners involved breaking the contact between the gun tube and liner by "a sudden cooling of the inner member [to] contract it away from the still heated and expanded outer member" (Olson, p. 158).

Work in the shop fluctuated from below capacity in the mid-1890s, when a lack of funding cut production, to a boom during the Spanish-American War. Gun manufacture in the decade and a half before World War I was limited. To accommodate the increased work load during the war, the shop was enlarged. Production dropped markedly following the war, and by 1920 only a single wing of the shop was in operation; other gun production facilities at the arsenal were placed on standby. World War II brought a dramatic increase in output and enlargement of the building.

Following the war, the arsenal modernized its manufacturing equipment, especially in the Seacoast Gun Shop, where:

> ...machines were relocated, gun lathes lengthened, old equipment replaced and better foundations and beds were constructed for the huge boring and rifling machines. These latter, particularly for the 16-inch gun, were much improved as they were converted to better drive, lubrication and cooling systems. Some lathes were converted to be able to machine liners and jackets up to 68 feet in length and were fitted with new tapering equipment. The tapering equipment was completely installed by January, 1948, and the units performed with the "utmost precision" during tests. By late 1948 the heat treating shop in Building 110 had been equipped with anodizing, parkerizing, parco-lubriting and chrome-plating equipment. The chrome plating unit was intended primarily for smaller objects up to and including 3-inch and 90 mm. tubes.
>
> Work was also begun in the spring of 1949 to install the huge new honing machine in Building 110. This machine was designed to handle pieces up to 36 inches in diameter and 70 feet in length (A History of Watervliet Arsenal, pp. 155-156).

In 1960 Watervliet received an order for the production of sustainer motors for the Nike-Hercules anti-aircraft defense missile. Excavation, paving, and miscellaneous steel work was done to convert the south end of the shop into a manufacturing center for the motors,

which "were designed to propel the missile in flight after initial blast off" (Ibid, p. 187). The following year, the south end of the shop was further modified to manufacture Terrier missiles, the principal air defense weapon of missile cruisers and destroyers, for the Navy. Lathes were removed, and a "gantry furnace, a huge cylindrical heating apparatus mounted on rails over a 32-by-84-foot pit containing six underground quenching cylinders in a row" was installed (Ibid, p. 191).

Project REARM brought further changes to the building. The heat treat department and passageways to buildings on the east of the shop were demolished. The shop is currently in operation on a limited basis. (For further documentation see HAER No. NY-1A.)

PART II. ARCHITECTURAL INFORMATION

A. Ceneral Statement:

1. Architectural character: One of the arsenal's largest manufacturing facilities, the building consists of a tall one story, gable-roofed main aisle, one-story, shed-roofed side aisles, and several additions along the west side. The elevations are punctuated by large window openings and articulated by brick pilasters and an elaborate corbelled brick cornice and chimneys.

2. Condition of fabric: With the exception of many of the wood sash, the building is generally in good condition and is well maintained.

B. Description of Exterior:

1. Over-all dimensions: The north wing measures 128' 11" (north) x 443' 2". On the west side, an addition 25' 2" wide and 287' 2" long is set 76' from the north end of the wing. The central section is approximately 86' long x 120' wide and has a 75' 8" x 49' 8" extension on the west, which originally contained the boiler house. On the east side, is a projection 12' deep x 60' wide. The south wing is 690' 8" long and 159' 2" wide on the north and 129' wide on the south. On the west side, an extension 383' 4" long x 48' 6" wide is set 125' 3" from the north end of the wing. The welding shop on the south end of the extension measures 53' 9" wide x 140' 6" long.

The north and south wings are tall one story over the center aisle and one story over the side aisles. A high bay extends

approximately 118' over the central section. Extensions on the east and west sides are one story.

2. Foundations: Exterior wall foundations of the north and south wings and central section are rubble stone laid on concrete; remaining foundations of these sections are brick laid on concrete. The water table is cut stone. Foundations of the west extension on the north wing and the welding shop on the south wing are concrete on concrete piers.

3. Walls: Walls of all sections are red brick laid in 5/1 common bond. Plain brick pilasters, separating the bays, rise from the water table to a corbelled brick cornice on the east, west, and north sides of the main and side aisles (see HAER Photo No. NY-1B-1 and HAER Photo No. NY-1B-2) and the north and south elevations of the boiler house on the central section. Battered brick piers, separating the bays on the south elevation, rise to a corbelled cornice (HAER Photo No. NY-1B-5). The west extensions on the north and south wings exhibit similar detailing (HAER Photo No. NY-1B-3 and HAER Photo No. NY-1B-2). Main aisle gable ends are pedimented with elaborate corbelled raking and horizontal cornices. The north and south walls of the high bay are stuccoed.

4. Structural system, framing: Massive load bearing brick walls, punctuated by regularly-spaced, round-arched openings on the lower level and segmentally-arched window openings on the upper level, divide the length of the building into a main aisle and side aisles (HAER Photo No. NY-1B-32 and HAER Photo No. NY-1B-33). The roof truss shoes rest on brick piers which separate the window openings on the upper level, and the roof is supported by iron trusses (HAER Photo No. NY-1B-36 and HAER Photo No. NY-1B-37). Overhead cranes travel the length of the main aisle along steel rails supported by I-beams with x-braces every other bay. The supporting beams are offset slightly from the wall along the east side and set further from the wall on the west to allow for a catwalk that provides access to the cranes (HAER Photo No. NY-1B-43 and HAER Photo No. NY-1B-53). The supporting beams are anchored into the wall by metal I-beams both at midpoint and just below the crane rail. Side aisles have a timber truss with a metal I-beam for the bottom chord (HAER Photo No. NY-1B-38 and HAER Photo No. NY-1B-39).

   In the high bay, vertical heavy metal beams coinciding with the bays on the east and west sides support two crane rails, the lowest of which is continuous with the craneways in the north and south wings. Horizontal beams divide the spaces between the vertical beams into a grid filled with x-braces (HAER Photo No.

NY-1B-48). The roof truss is metal (HAER Photo No. NY-1B-48). The west extensions on the north and south wings have structural steel frames and steel roof trusses.

5. Chimneys: On the central section, four chimneys rise along the east elevation of the east extension (HAER Photo No. NY-1B-7 and HAER Photo No. NY-1B-10). On the two center chimneys, a high brick base rises to corbelled brick courses and a stone cap forming the base for paneled brick pilasters and corbelled brick cornices. The chimney is capped by brick panels and an elaborate stone and corbelled brick cornice. The end chimneys have plain brick walls, architraves with corbelled cornices and paneled and corbelled brick caps. The end chimneys have been covered with hipped roofs. Similar chimney caps rise above pilasters separating the second and third bays to the north and south of the high bay.

6. Openings:

   a. Doorways and doors: The principal entrance to the main aisle of the north wing is centered on the north elevation. Four heavy paneled wood doors with four lights above x-braces are set below two eight-light transoms and multi-light sash in a round-arched opening (HAER Photo No. NY-1B-8). The opening has a triple-header course lintel. Similar but simpler doorways are set in the north elevation of the side aisles (HAER Photo No. NY-1B-1).

      On the south elevation, a modern metal overhead door is set in a rectangular opening in the third bay of the main aisle (HAER Photo No. NY-1B-5). Metal overhead doors set in arched openings with triple-header brick course lintels open into the side aisles.

      On the east, the south wing's east aisle is punctuated by metal overhead doors in the second and fifth bays; by glazed wood doors similar to those on the north elevation of the north wing's side aisles in the 19th and 33rd bays (HAER Photo No. NY-1B-7); and by glazed wood personnel doors in the 22nd bay. Double wood and nine-light doors set under multilight sash in a round-arched opening provide access to the north end of the aisle. Two modern metal overhead doors set under multilight sash in round-arched openings with triple header course lintels are adjacent to the high bay on the south. The openings provide access for rail lines, which cross the building from west to east. Doors north of the high bay are similar to those on the north elevation of the side aisles.

The west extension to the north wing has a modern metal overhead door on the north and a glazed metal personnel door framed by metal sash in the last bay on the south. Two metal overhead doors open south of the high bay to provide rail access to the interior. The west side aisle of the south wing has metal ovehead doors on the north and double metal personnel doors near the center of the west elevation. Double glazed metal personnel doors set below steel sash and a steel lintel are on the west elevation of the west extension, and its south end is punctuated by a rectangular metal overhead door.

b. Windows: Windows on the first level of the north elevation are multilight wood sash set in tall round-arched openings. Just below the springing line of the arch, the horizontal frame member is decorated with raised medalions (HAER Photo No. NY-1B-8). First level main aisle windows on the central section are undecorated, tall, multilight wood sash set in tall round-arched openings. Second level main aisle windows are multilight wood sash set under segmental-arched openings (HAER Photo No. NY-1B-12). The first and second level windows in the southernmost 16 bays of the south wing are metal sash. Second level windows on the east extension of the central section are multilight wood sash in arched openings, which spring from brick capitals. Those in the center are paired and placed under a second brick arch that springs from capitals flanking the windows. All have brick triple header course lintels and stone lug sills. Northeast, northwest, and southeast side aisles have multilight sash set under broad round arches (HAER Photo No. NY-1B-12). Windows on the southwest aisle are metal sash with corbelled brick lintels and stone sills. Windows on the south elevation are multilight metal sash set in tall segmentally-arched openings with brick double header course lintels (HAER Photo No. NY-1B-5). East and west gable ends of the main aisle are pierced by circular windows with brick surrounds.

End bay windows and first level second, third, and fourth bay windows of the high bay are multilight metal sash under segmental-arch lintels. Second level windows in the second, third, and fourth bays are tall multilight metal sash in round-arched openings. Lintels are brick triple header courses, and sills are stone. First level windows in the second, third, and fourth bays on the east elevation of the high bay are covered by the east extension.

The west extensions on the north and south wings have rectangular industrial steel sash with metal lintels and concrete lug sills.

7. Roof:

a. Shape, covering: Roofs of the main aisle, high bay, east extension of the central section, and the boiler house are asphalt-shingled gables. Side aisles and the west extension to the south wing have asphalt-shingled shed roofs. The flat roof on the west extension of the north wing is built-up.

b. Cornice, eaves: Cornices on the main aisle, side aisles, east extension of the central section, high bay, and boiler house are elaborate corbelled brick. The horizontal cornice on the north gable end is punctuated by metal tie rods and plates above the pilasters. West extensions on the north and south wings have less elaborate corbelled cornices.

C. Description of Interior:

1. Floor plans: The north wing is divided longitudinally into the main aisle and two side aisles. The main aisle and east side aisle are open. The west aisle is open except for an office on the south end and a partitioned room and caged area on the north. The west extension opens onto the west side aisle. The main aisle contains larger machinery, including lathes, riflers, and presses (HAER Photo No. NY-1B-49). Small components machinery is located in the side aisles and west extension. Overhead cranes run the length of all sections. (See supplemental material, floor plans)

The central section contains the shrinkage pit, which is approximately 80' deep, under the high bay and a dynamo room, restrooms, and service areas on the west (HAER Photo No. NY-1B-51 and HAER Photo No. NY-1B-52). South of the high bays, two rail lines cross the building from west to east (HAER Photo No. NY-1B-58). (See supplemental material, floor plans)

The south wing is divided into the main aisle and two side aisles. All three aisles are open except the north end of the west aisle, which is partitioned into storage rooms, offices, and restrooms. The west extension opens onto the west aisle and is partitioned in the southwest corner for restrooms, a locker room, and closet. To the south is the welding shop. The main aisle contains larger machinery, including lathes, riflers, and presses (HAER Photo No. NY-1B-50 and HAER Photo No. NY-1B-54).

The lathes located in this wing can accommodate the 16-inch gun (HAER Photo No. NY-1B-62 and HAER Photo No. NY-1B-63). Hydraulic autofrettage equipment and an area for processing gun tubes are located at the south end of the wing.

The west side aisle and west extension contain small components machinery. Overhead cranes run the length of all sections. (See supplemental material, floor plans)

Two levels of catwalks providing access to the overhead cranes are located along the west wall of the main aisle. Stairs leading to the catwalks are at the south and north ends of the north wing.

2. Stairways: The north stairs are open, straight-run with wood treads and a metal pipe rail. The south stairs are steel, open, straight-run with metal pipe railing. Stairs at the south end of the catwalk leading to the second level catwalk are wood straight-run with metal pipe railing.

3. Flooring: Floors are concrete except in the east and west side aisles of the north wing where they are end grain wood block.

4. Wall and ceiling finish: Exterior walls and those dividing the interior are brick. Partition walls are concrete block, metal, and beaded wood paneling. Ceilings are formed by the wood deck of the roof.

5. Openings:

   a. Doorways and doors: Interior doors are metal or wood personnel.

   b. Windows: Windows are set in the brick openings and have no frames.

6. Mechanical equipment:

   a. Heating, air conditioning, ventilation: The building is heated by steam. Ventilation is provided through the windows.

   b. Lighting: Light from the windows is supplemented by incandescent fixtures hung from the roof trusses.

   c. Plumbing: Plumbing fixtures are modern.

D. Site:

The shop is located between Hagner Road on the north, Parker Road on the south, Whittemore Road on the west, and Schull Road on the east. At the center of the arsenal's manufacturing area, it is surrounded on the east and west by additional manufacturing facilities. Much of the east elevation is obscured by Building 35, which is separated from the gun shop by Schull Road. The shop extends nearly to the arsenal's south boundary fence and faces a family housing unit and the headquarters building on the north.

PART III. SOURCES OF INFORMATION

A. Architectural Drawings:

The arsenal's Engineering Division has a collection of 85 original and early drawings (most of which are undated) for the north and south wings and the central section. The drawings include elevations, plans, sections, cornices, and roof trusses. (See HAER Photo No. NY-1B-19 through HAER Photo No. NY-1B-47)

Large Gun Shop South Extension. 1916-1917. 38 sheets, includes elevations, plans, trusses, craneways, and steam heating system. Watervliet Arsenal Engineering Division. First extension to south side of south wing and enlargement of southwest aisle.

Extension to South Wing of Seacoast Cannon Shop. 1919. 10 sheets, includes elevations, cross sections, and plans. Watervliet Arsenal Engineering Division. Addition of 10 bays on the south side of the south wing.

Addition to West Side of Northwest Aisle. 1919. 3 sheets, includes elevations and plans. Watervliet Arsenal Engineering Division. First extension to northwest aisle.

Addition to West Side of Northwest Aisle. 1941. 2 sheets, includes elevations and plans. Watervliet Arsenal Engineering Division. Second extension to northwest aisle.

Extension to Southwest Aisle. 1941. 2 sheets, includes elevation and plan. Watervliet Arsenal Engineering Division. Current welding shop.

B. Early Views:

A large number of photographs showing the exterior and interior of the building, most of which date from the turn of the century to the

present, are in the collection of the Watervliet Arsenal Museum. (See HAER Photo No. NY-1B-13 through HAER Photo No. NY-1B-18)

C. Interviews:

Interview with John Kacharian, the arsenal's historical consultant, conducted by Barbara E. Hightower on November 14, 1984. Provided information on machinery and production in the building.

D. Bibliography:

Secondary and published sources:

Annual Report of the Secretary of War for the Year 1893. Vol. 3, Ordnance. Washington, D.C.: Government Printing Office, 1893. Gives production figures.

Annual Report of the Secretary of War for the Year 1894. Vol. 3, Ordnance. Washington, D.C.: Government Printing Office, 1895. Contains illustration of machinery and furnaces in shrink pit.

Annual Report of the Secretary of War for the Fiscal Year Ended June 30, 1895. Washington, D.C.: Government Printing Office, 1896. Gives production figures.

Annual Report of the Secretary of War for the Year 1896. Vol. 3, Ordnance. Washington, D.C.: Government Printing Office, 1897. Gives production figures.

Annual Report of the Secretary of War for the Fiscal Year Ended June 30, 1897, Report of the Chief of Ordnance. Washington, D.C.: Government Printing Office, 1897. Notes trouble with securing forgings from private manufacturers and production figures.

Annual Report of the War Department for the Fiscal Year Ended June 30, 1901, Report of the Chief of Ordnance. Washington, D.C.: Government Printing Office, 1902. Gives progress of construction on 16-inch gun, production figures, and details of repair work on the cornice.

Building Technology, Inc. Historic Properties Report Watervliet Arsenal, Watervliet, New York and Rotterdam Family Housing Area, Rotterdam, New York. January 1985. The report and inventory cards for the arsenal are filed as field records in the Prints and Photographs Division, Library of Congress under HAER No. NY-1A.

Farley, J. P. "The 16-Inch Breech-Loading Rifle, Type, Model 1895." In Notes on the Construction of Ordnance--No. 78. Washington, D.C.: November 27, 1900.

Herb, Charles O. "How Guns Are Built at the Watervliet Arsenal." Machinery 35 (November 1928): 161-167.

A History of Watervliet Arsenal 1813 to Modernization 1982. Watervliet, New York: U.S. Army, Watervliet Arsenal, n.d.

Kyle, Francis K. A History of Watervliet Arsenal. Watervliet, New York: Watervliet Arsenal, 1920.

Olson, Oscar. "Shrinkage Operations in the Construction of Built-up Cannon--As Practiced at Watervliet Arsenal." Army Ordnance 8 (November-December 1927): 156-160.

Smith, Hugh. "Manufacture of Cannon at Watervliet Arsenal: Development of Modern Types and Production Methods." Army Ordnance 8 (November-December 1927): 149-155.

U.S. Congress. House. Report of the Secretary of War. Vol. 2538, 1887. Gives brief background on selection of Watervliet Arsenal as site for gun factory.

_____. Report of the Secretary of War. Vol. 2720, 1889. Lists members of board appointed to design the gun shop and contractors.

_____. Report of the Secretary of War. Vol. 2836, 1890. Outlines progress of construction of north wing and central section and discusses need for erection of south wing.

_____. Report of the Secretary of War. Vol. 2928, 1891. Outlines progress of construction, production, and machinery.

_____. Report of the Secretary of War. Vol. 3083, 1892. Contains specifications for the power plant, list of machinery, and progress of construction.

E. Likely Sources Not Yet Investigated:

Records of the Office of the Chief of Ordnance, Record Group 156, and Records of the Office of the Chief of Engineers, Record Group 77, Navy and Old Army Branch, National Archives, Washington, D. C. should be further investigated.

F. Supplemental Material:

Heavy Caliber Tube Shop, Building No. 110, South End, Center Section, North End. No date. Watervliet Arsenal Engineering Division. Recent floor plan of the building; heat treat area, cyanide treatment plant, tool crib and passages on the east elevation of the north wing have been removed as part of Project REARM remodeling.

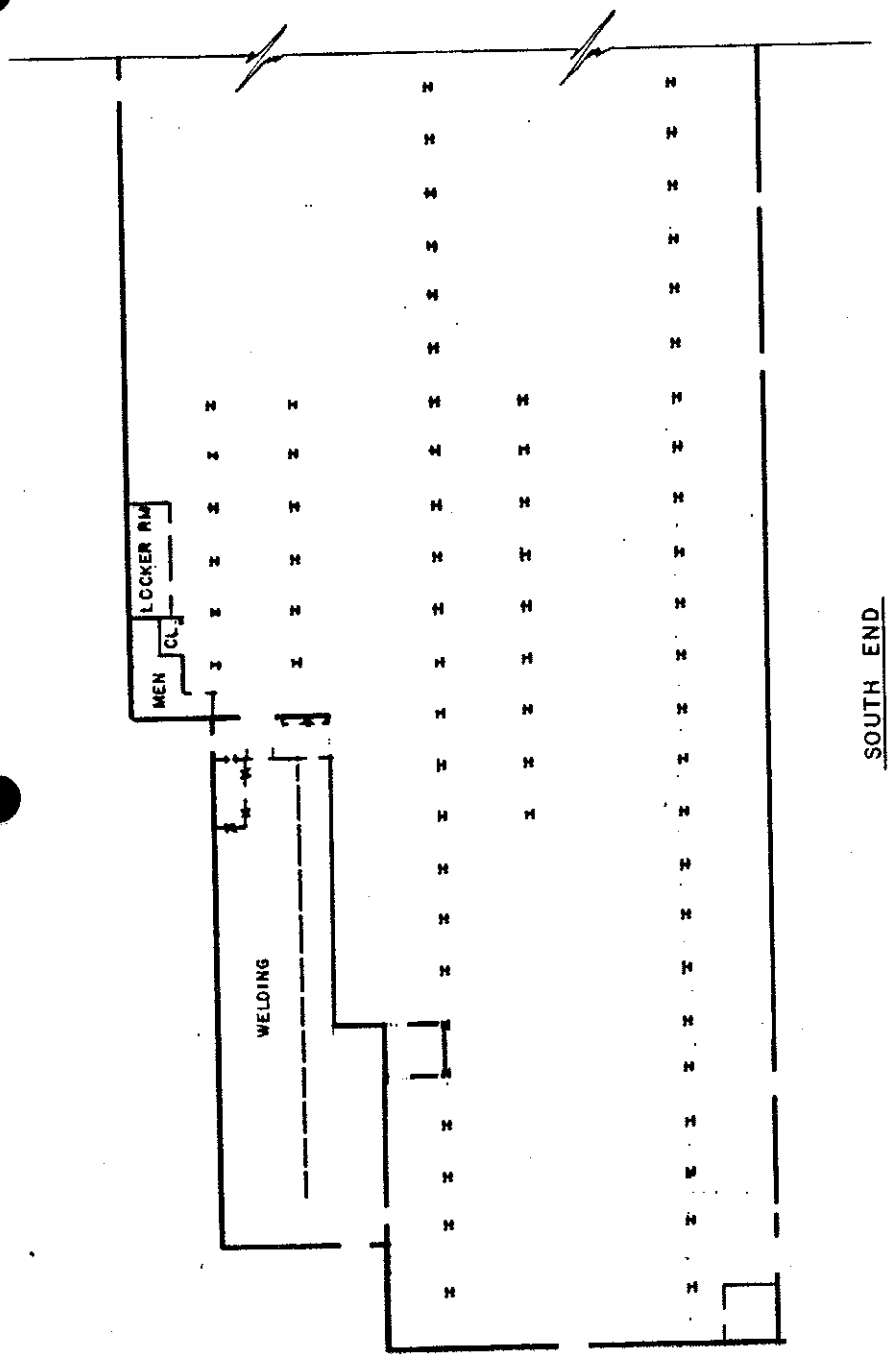
Prepared by: Barbara E. Hightower
Historian
MacDonald and Mack Partnership
February 1985

PART 1V. PROJECT 1NFORMATION

This project was part of a program initiated through a memorandum of agreement between the National Park Service and the U.S. Department of the Army. Stanley H. Fried, Chief, Real Estate Branch of Headquarters DARCOM, and Dr. Robert J. Kapsch, Chief of the Historic American Buildings Survey/Historic American Engineering Record, were program directors. Sally Kress Tompkins of HABS/HAER was program manager, and Robie S. Lange of HABS/HAER was project manager. Under the direction of William A. Brenner, Building Technology Incorporated, Silver Spring, Maryland, acted as primary contractor, and MacDonald and Mack Partnership, Minneapolis, was a major subcontractor. The project included a survey of historic properties at Watervliet Arsenal, as well as preparation of an historic properties report and HABS/HAER documentation for 17 buildings. The survey, report, and documentation were completed by Barbara E. Hightower, historian, Minneapolis. The photographs were taken by Robert A. Ryan and J Ceronie of Dennett, Muessig, Ryan, and Associates, Ltd., lowa City, Iowa. Drawings were produced by Gary M. Louris, Minneapolis.

F. Supplemental Material
Floor Plan

WATERVLIET ARSENAL
SEACOAST GUN SHOP
(Building 110, Big Gun Shop)
HAER No. NY-1-B (Page 22)

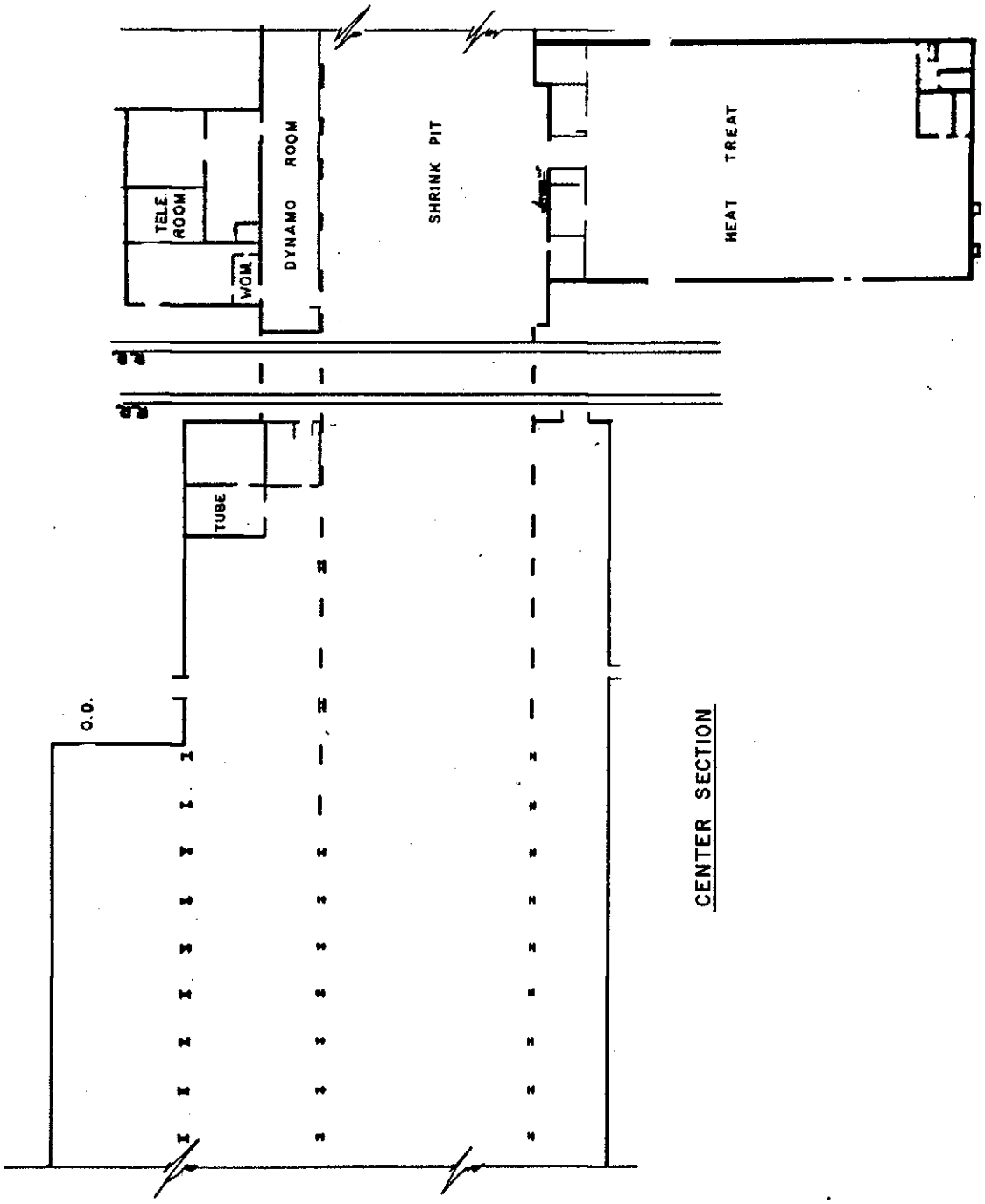


WATERVLIET ARSENAL
WATERVLIET, N.Y.
Drawn by: V.R.GANGEMI, A.E. Appd by:
Revisions | Date
HEAVY CALIBER
TUBE SHOP
BUILDING NO. 110
Scale: 1" = 40'-0" Date:

NET FLOOR AREA
211,625
Square feet
FLOOR CAPACITY
1000-200-200 LBS

F. Supplemental Material
Floor Plan

WATERVLIET ARSENAL
SEACOAST GUN SHOP
(Building 110, Big Gun Shop)
HAER No. NY-1 B (Page 23)



WATERVLIET ARSENAL
WATERVLIET, N.Y.
Drawn by: J.R.GANGEMI, A.E. App'd by:
Revisions Date
HEAVY CALIBER
TUBE SHOP
BUILDING NO. 110
Scale: 1"=40'-0" Date:

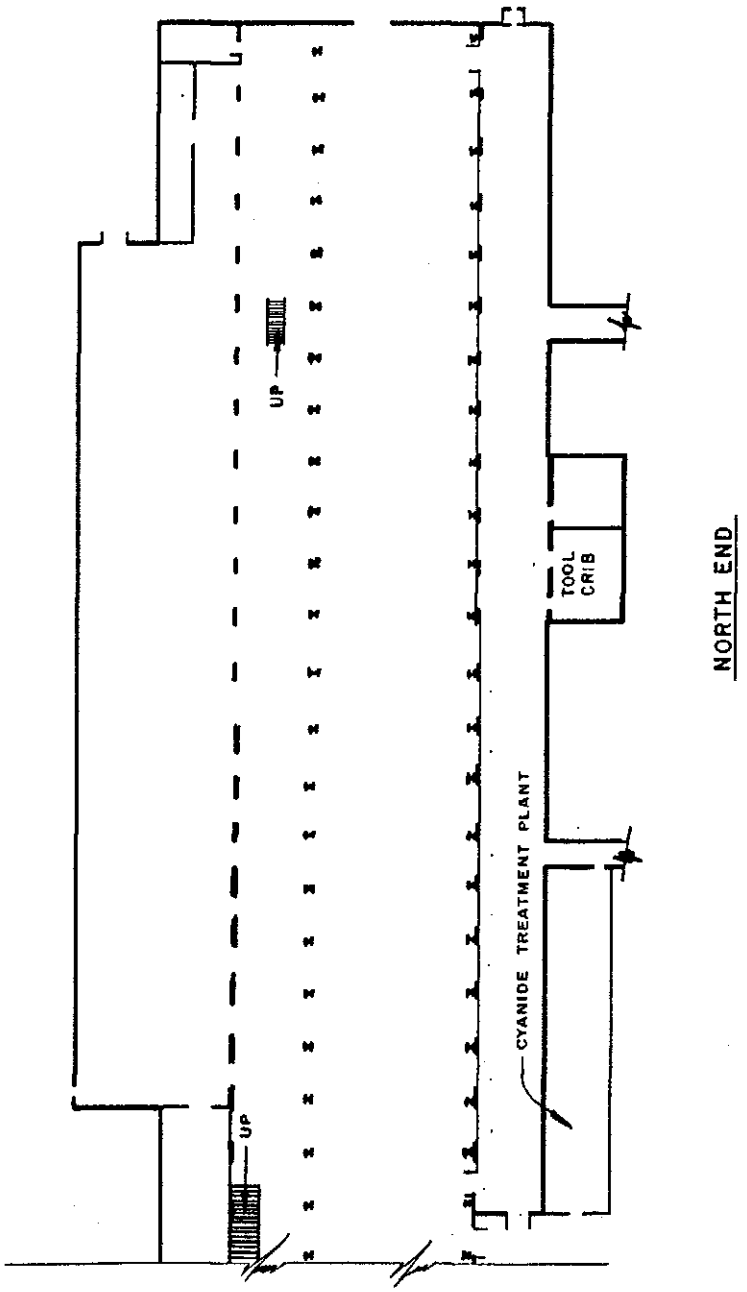
N

NET FLOOR AREA
211 625
Square feet

FLOOR CAPACITY
1000-200-200 LBS
Per square foot

F. Supplemental Material
Floor Plan

WATERVLIET ARSENAL
SEACOAST GUN SHOP
(Building 110, Big Gun Shop)
HAER No. NY-1-B (Page 24)



WATERVLIET ARSENAL
WATERVLIET, N.Y.
Drawn by: J.R.GANGEMI, A.E. Appd by:
Revisions | Date
HEAVY CALIBER
TUBE SHOP
BUILDING NO. 110

NET FLOOR AREA
21625
Square feet

FLOOR CAPACITY
1000-200-200 LBS